

# PATENT ABSTRACTS OF JAPAN

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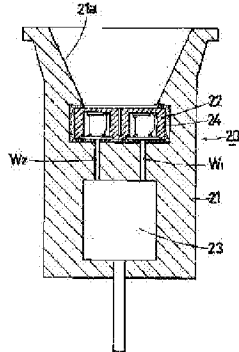
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## (54) ULTRASONIC TRANSMITTER-RECEIVER



(57)Abstract:

PROBLEM TO BE SOLVED: To downsize and improve the short-range detection capability.

SOLUTION: The transmitter-receiver contains an ultrasonic vibrator 22 having a transmission case that is equipped with a transmission piezoelectric element and is closed by a transmission diaphragm at one end of its cylindrical body, a reception case that is equipped with a receiving piezoelectric element and is closed by a reception diaphragm at one end of its cylindrical body, and a connecting piece that connects the transmission case and the receiving case, is stored in a housing 21. In such case, the transmission case and the receiving case are connected only at parts near the opening of the transmission case and the opening

of the reception case by the connecting piece. A cushioning material is placed in a clearance between the transmission case and the reception case connected by the connection piece.

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#### CLAIMS

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[Claim(s)]

[Claim 1] The case section for wave transmission which was equipped with the piezoelectric device for wave transmission, and blockaded the end of a tube-like object with the diaphragm for wave transmission, The case section for wave-receiving which was equipped with the piezoelectric device for wave-receiving, and blockaded the end of a tube-like object with the diaphragm for wave-receiving, It is the ultrasonic transducer

which contained in housing the ultrasonic vibrator which has the piece section of connection which connects the case section for wave transmission, and the case section for wave-receiving with juxtaposition. By said piece section of connection The ultrasonic transducer characterized by connecting the case section for wave transmission, and the case section for wave-receiving near the opening of the case section for wave-receiving near the opening of the case section for wave transmission.

[Claim 2] The ultrasonic transducer according to claim 1 characterized by placing shock absorbing material between the clearance between the case sections for wave transmission and the case sections for wave-receiving which were connected by said piece section of connection.

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[Translation done.]

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#### DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the ultrasonic transducer of the ultrasonic sensor which receives the reflected wave from an obstruction and detects existence of an obstruction while transmitting an ultrasonic signal.

[0002]

[Description of the Prior Art] The principle explanatory view in which drawing 5 shows an ultrasonic sensor, the sectional view showing the ultrasonic transducer of the former [ drawing 6 ], and drawing 7 are the sectional views showing the ultrasonic vibrator of the conventional ultrasonic transducer. Drawing 8 is the transmission-and-reception wave signal-description Fig. of the conventional ultrasonic transducer, drawing 8 (a) is a wave transmission signal-description Fig., and

drawing 8 (b) is a wave-receiving signal-description Fig. Drawing 9 is the sectional view showing other conventional ultrasonic transducers. [0003] When Obstruction A exists ahead, it is made for the principle of an ultrasonic sensor to have the distance L to Obstruction A detected based on a duration until the ultrasonic signal B which transmitted waves to front space reflects with Obstruction A and returns from an ultrasonic transducer 1 again, as shown in drawing 5 .

[0004] By the way, if it is in the conventional ultrasonic sensor, the ultrasonic transducer 1 as shown in drawing 6 is used. That is, an ultrasonic transducer 1 is equipped with the housing 2 made from the mold goods made of resin, the ultrasonic vibrator 3 contained in housing 2, and the circuit block 4. Housing 2 is equipped with horn section 2a for transmitting a supersonic wave in the shape of a beam efficiently to the front. An ultrasonic vibrator 3 changes an electrical signal into mechanical oscillation, it is the part which vibrates air directly, or is made into an electrical signal after changing vibration of air into mechanical oscillation, and intervenes and contains the maintenance material 5, such as silicone rubber in which the part which a supersonic wave outputs and inputs carries out opening, in housing 2. Through shielding-wire W, an electrical signal is supplied to an ultrasonic vibrator 3, or the circuit block 4 amplifies the electrical signal inputted from an ultrasonic vibrator 3.

[0005] An ultrasonic vibrator 3 is the sheet metal section three a1 of case 3a made from aluminum which blockaded the end of a tube-like object in the sheet metal section three a1 as shown in drawing 7 in detail, and case 3a. It consists of tabular small piezoelectric-device 3b stuck on an inside, and circuit board 3c which lids the opening side of case 3a. Shielding-wire W is connected to circuit board 3c, and it is 1 from circuit board 3c 3d of lead wire by the side of a live wire. Lead-wire 3d2 by the side of a ground It is pulled out and is 1 3d of lead wire. It connects with piezoelectric-device 3b, and is 2 3d of lead wire. The sheet metal section three a1 near the piezoelectric-device 3b It connects.

[0006] The conventional ultrasonic transducer 1 constituted as mentioned above is equipped with the transmission-and-reception wave property of an ultrasonic signal as shown in drawing 8 . That is, a driving signal as shown in drawing 8 (a) is impressed to piezoelectric-device 3b, and it is the sheet metal section three a1. If it is made to vibrate and a supersonic wave is transmitted, as shown in drawing 8 (b), the reverberation signal by reverberation vibration will appear after a driving signal, and the reflected wave from Obstruction A will come on

the contrary in a  $T=2 L/V$  second from drive initiation of piezoelectric-device 3b. However,  $V$  is acoustic velocity.

[0007]

[Problem(s) to be Solved by the Invention] therefore, so that the ultrasonic transducer 1 of drawing 5 and distance with Obstruction A become short -- the reflected wave from the obstruction A of drawing 8 (b) -- increasingly -- a reverberation signal -- approaching -- a reflected wave -- just -- being alike -- it will hide into the reverberation signal. Therefore, if it is in an ultrasonic sensor equipped with the conventional ultrasonic transducer 1 of a configuration as shown in drawing 6, Obstruction A can be detected when the distance of Obstruction A and an ultrasonic transducer 1 approaches not much.

[0008] Then, in order to prevent the fall of the short-distance ability to detect by reverberation vibration of an ultrasonic vibrator 3, the ultrasonic transducer using the ultrasonic vibrator of the form according to transmission and reception which reverberation vibration does not produce is devised, and the structure of the ultrasonic transducer is shown in drawing 9. The ultrasonic transducer 6 shown in drawing 9 is equipped with ultrasonic vibrator 8a for wave transmission and ultrasonic vibrator 8b for wave-receiving which are contained in the housing 7 made from the mold goods made of resin, and housing 7, and the circuit block 9.

[0009] Housing 7 is equipped with horn section 7a for transmitting a supersonic wave in the shape of a beam efficiently to the front, and horn section 7b for receiving a supersonic wave efficiently from the front. Ultrasonic vibrator 8a changes an electrical signal into mechanical oscillation, and vibrates air directly, and ultrasonic vibrator 8b is made into an electrical signal after changing vibration of air into mechanical oscillation. It is constituted like the ultrasonic vibrator shown in drawing 7, and gets down, and each of ultrasonic vibrators 8a and 8b intervenes, and contains the maintenance material 10, such as silicone rubber in which the part which a supersonic wave outputs and inputs carries out opening, in housing 7. Through shielding-wire W, an electrical signal is supplied to ultrasonic vibrator 8a, or the circuit block 9 amplifies the electrical signal inputted from ultrasonic vibrator 8b.

[0010] However, if it is in the ultrasonic transducer 6 as shown in drawing 9 It compares with the ultrasonic transducer 1 using the ultrasonic vibrator 3 of a transmission-and-reception combination configuration as shown in drawing 6. Since the effect by \*\*\*\*

reverberation vibration ultrasonic vibrator 8a and whose ultrasonic vibrator 8b are another objects is mitigated, although short-distance ability to detect improves An ultrasonic vibrator, maintenance material, and the horn section needed to be prepared every [ 2 ], respectively, and there was a trouble cost not only increases, but that a configuration will become large that it is hard to assemble.

[0011] The place which accomplished in order that this invention might solve the above-mentioned trouble, and is made into the purpose is to offer the excellent ultrasonic transducer whose short-distance ability to detect made it can miniaturize and cheap and improved.

[0012]

[Means for Solving the Problem] If this invention is in invention according to claim 1 in order to solve the above-mentioned trouble The case section for wave transmission which was equipped with the piezoelectric device for wave transmission, and blockaded the end of a tube-like object with the diaphragm for wave transmission, The case section for wave-receiving which was equipped with the piezoelectric device for wave-receiving, and blockaded the end of a tube-like object with the diaphragm for wave-receiving, It is the ultrasonic transducer which contained in housing the ultrasonic vibrator which has the piece section of connection which connects the case section for wave transmission, and the case section for wave-receiving with juxtaposition. By said piece section of connection Near the opening of the case section for wave-receiving near the opening of the case section for wave transmission, it is characterized by connecting the case section for wave transmission, and the case section for wave-receiving.

[0013] Moreover, if it is in invention according to claim 2, it is characterized by placing shock absorbing material between the clearance between the case sections for wave transmission and the case sections for wave-receiving which were connected by said piece section of connection.

[0014]

[Embodiment of the Invention] Hereafter, based on drawing 1 - drawing 3 , the gestalt of other operations is explained to a detail for the gestalt of 1 operation of the ultrasonic transducer concerning this invention based on drawing 4 , respectively.

[0015] Drawing 1 is the sectional view showing an ultrasonic transducer. Drawing 2 is drawing showing an ultrasonic vibrator, drawing 2 (a) is a top view and drawing 2 (b) is a sectional view. Drawing 3 is a side elevation explaining the oscillation mode. Drawing 4 is drawing showing the ultrasonic vibrator of the ultrasonic transducer of the gestalt of

other operations, drawing 4 (a) is a top view and drawing 4 (b) is a sectional view.

[0016] An ultrasonic transducer 20 is equipped with the housing 21 made from the mold goods made of resin, the ultrasonic vibrator 22 contained in housing 21, and the circuit block 23. Housing 21 is equipped with horn section 21a for transmitting a supersonic wave in the shape of a beam efficiently to the front. An ultrasonic vibrator 22 is a part which changes an electrical signal into mechanical oscillation, and vibrates air directly, or is changed into an electrical signal after changing vibration of air into mechanical oscillation, intervenes and contains the maintenance material 24, such as silicone rubber in which the part which a supersonic wave outputs and inputs carries out opening, in housing 21. The circuit block 23 minds shielding wire W1, and is shielding wire W2 in supplying an electrical signal to an ultrasonic vibrator 22 \*\*\*\*. The electrical signal which minds and is inputted from an ultrasonic vibrator 22 is amplified.

[0017] An ultrasonic vibrator 22 is the diaphragm 22a1 for wave transmission about the end of a tube-like object, as shown in drawing 2 in detail. Blockaded case section 22a for wave transmission made from aluminum, It is the diaphragm 22b1 for wave-receiving about the end of a tube-like object. Blockaded case section 22b for wave-receiving made from aluminum, Piece section of connection 22c which connects case section 22a for wave transmission, and case section 22b for wave-receiving, Diaphragm 22a1 for wave transmission of case section 22a for wave transmission 22d of tabular small piezoelectric devices for wave transmission stuck on an inside, Diaphragm 22b1 for wave-receiving of case section 22b for wave-receiving It consists of 22f of the circuit boards which lid tabular small piezoelectric-device 22e for wave-receiving stuck on an inside, and opening of case section 22a for wave transmission, and 22g of the circuit boards which lid opening of case section 22b for wave-receiving.

[0018] In 22f of circuit boards, it is shielding wire W1. It connects and is shielding wire W2 in 22g of circuit boards. It connects. From 22f of circuit boards, it is 1 22h of lead wire by the side of a live wire. Lead-wire 22h2 by the side of a ground It is pulled out and is 1 22h of lead wire. It connects with 22d of piezoelectric devices for wave transmission, and is 2 22h of lead wire. Diaphragm 22a1 for wave transmission near the 22d of the piezoelectric devices for wave transmission It connects. Moreover, from 22g of circuit boards, it is the lead wire 22i1 by the side of a live wire. Lead-wire 22 i2 by the side of a ground It is pulled out and is lead wire 22i1. It connects

with piezoelectric-device 22e for wave-receiving, and he is lead-wire 22 i2. Diaphragm 22b1 for wave-receiving near the piezoelectric-device 22e for wave-receiving It connects.

[0019] By the way, it is the next configuration that this ultrasonic vibrator 22 serves as the description. namely, diaphragm 22a1 for wave transmission from -- in order to transmit a supersonic wave, there is an object for \*\* which case section 22a for wave transmission must be vibrated by the supersonic wave of the frequency to be used, and vibrates in 22d of piezoelectric devices for wave transmission near the resonance frequency of case section 22a for wave transmission. Moreover, it is the diaphragm 22b1 for wave-receiving about the supersonic wave by which it reflects and comes on the contrary. If case section 22b for wave-receiving is not vibrated by the supersonic wave of the frequency to be used in order to receive waves and it is \*\*\*\*, there is nothing.

[0020] Then, although case section 22a for wave transmission and case section 22b for wave-receiving will be designed based on the frequency of the supersonic wave to be used, each of case section 22a for wave transmission and case section 22b for wave-receiving is the supersonic wave of the frequency to be used, and as shown in drawing 3 , it resonates in the mode in which opening becomes a knot (the amplitude is min) exactly. therefore, piece section of connection 22c -- with, if it connects near the opening of case section 22b for wave-receiving near the opening of case section 22a for wave transmission It will connect in the part which becomes a knot (the amplitude is min) when resonating by the supersonic wave of the frequency to be used. diaphragm 22a1 for wave transmission from -- vibration of case section 22a for wave transmission when transmitting a supersonic wave does not get across to case section 22b for wave-receiving through piece section of connection 22c, but can mitigate the effect by reverberation vibration, and is possible for that whose short-distance ability to detect improved.

[0021] Moreover, if it was in the conventional ultrasonic transducer which improved short-distance ability to detect, maintenance material holding an ultrasonic vibrator and an ultrasonic vibrator, such as silicone rubber, and every two horn sections prepared in housing needed to be prepared, respectively. If it is in this ultrasonic transducer 20 to it, since what is necessary is just to prepare horn section 21a prepared in the maintenance material 24 holding an ultrasonic vibrator 22 and an ultrasonic vibrator 22, such as silicone rubber, and housing 21 since it has connected with one through piece section of connection 22c every [ 1 ], it can decrease, the cost can be cut down and, as for case section 22a for wave transmission, and case section 22b for wave-



receiving, a configuration can also make small the number of components, and the number of assemblers.

[0022] Moreover, as shown in drawing 4 , the excellent ultrasonic transducer whose short-distance ability to detect was [ vibration of case section 22a for wave transmission ] propagation-hard to case section 22b for wave-receiving, could carry out shock absorbing material 25 like the sponge rubber which carries out absorption cutoff of a supersonic wave or the vibration, and made it can miniaturize and cheap further when placed between the clearance between case section 22a for wave transmission and case section 22b for wave-receiving, and improved further can be offered.

[0023]

[Effect of the Invention] Since the case section for wave transmission and the case section for wave-receiving are connected through the piece section of connection according to invention according to claim 1 Can decrease, can cut down the cost of the number of components, and the number of assemblers, can also make a configuration small, and, moreover, in the part of the knot of the oscillation mode of the case section for wave transmission by the supersonic wave of the frequency to be used Since the case section for wave transmission and the case section for wave-receiving will be connected through the piece section of connection, the effectiveness that the vibration at the time of wave transmission of the case section for wave transmission could not get across to the case section for wave-receiving easily, made it can miniaturize and cheap, and short-distance ability to detect's improved and that an excellent ultrasonic transducer can be offered is done so.

[0024] According to invention according to claim 2, since shock absorbing material is placed between the clearance between the case section for wave transmission, and the case section for wave-receiving, in addition to an effect of the invention according to claim 1, further, it is [ vibration of the case section for wave transmission ] propagation-hard in the case section for wave-receiving, it can be made into it, and the effectiveness which improved short-distance ability to detect further that an excellent ultrasonic transducer can be offered is done so.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the ultrasonic transducer of the gestalt of the 1 operation concerning this invention.

[Drawing 2] It is drawing showing the ultrasonic vibrator of the above-mentioned ultrasonic transducer.

[Drawing 3] It is a side elevation explaining the oscillation mode of the ultrasonic vibrator of the above-mentioned ultrasonic transducer.

[Drawing 4] It is the sectional view showing the ultrasonic vibrator of the ultrasonic transducer of the gestalt of other operations concerning this invention.

[Drawing 5] It is the principle explanatory view showing an ultrasonic sensor.

[Drawing 6] It is the sectional view showing the conventional ultrasonic transducer.

[Drawing 7] It is the sectional view showing the ultrasonic vibrator of the conventional ultrasonic transducer.

[Drawing 8] It is the transmission-and-reception wave signal-description Fig. of the conventional ultrasonic transducer.

[Drawing 9] It is the sectional view showing other conventional ultrasonic transducers.

[Description of Notations]

20 Ultrasonic Transducer

21 Housing

22a The case section for wave transmission

22a1 Diaphragm for wave transmission

22b The case section for wave-receiving

22b1 Diaphragm for wave-receiving

22d Piezoelectric device for wave transmission

22e The piezoelectric device for wave-receiving

22c Piece section of connection

25 Shock Absorbing Material

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[Translation done.]

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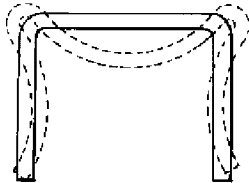
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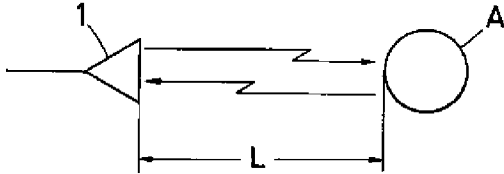
DRAWINGS

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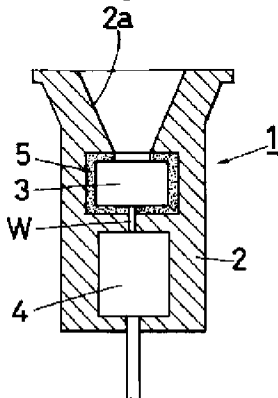
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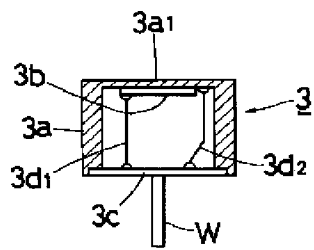
[Drawing 5]



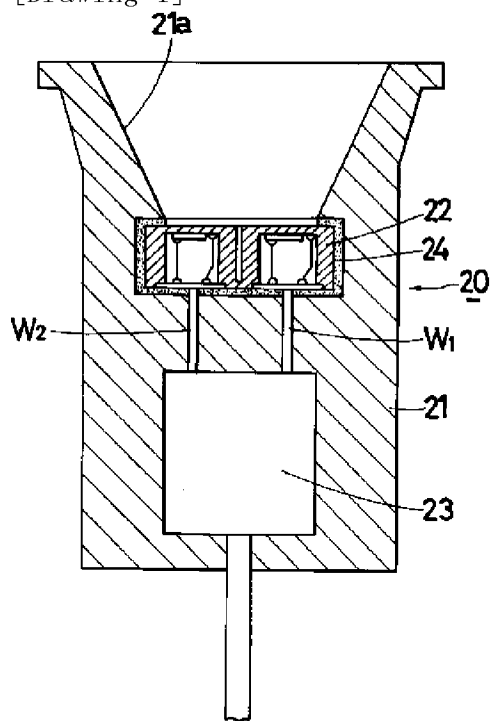
[Drawing 6]



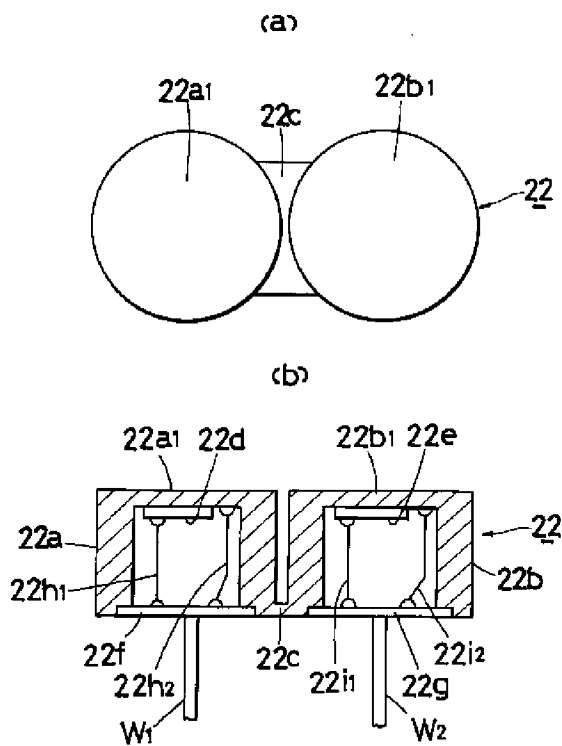
[Drawing 7]



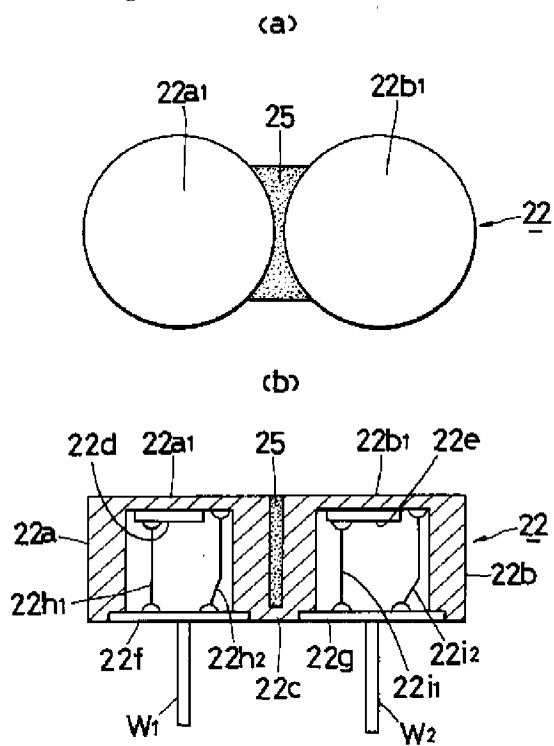
[Drawing 1]



[Drawing 2]

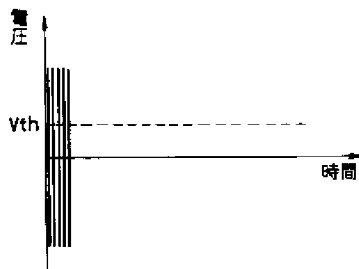


[Drawing 4]

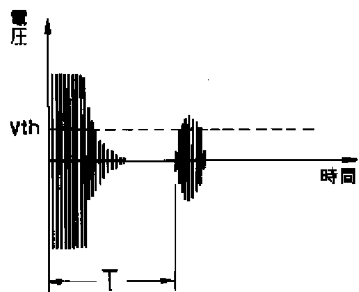


[Drawing 8]

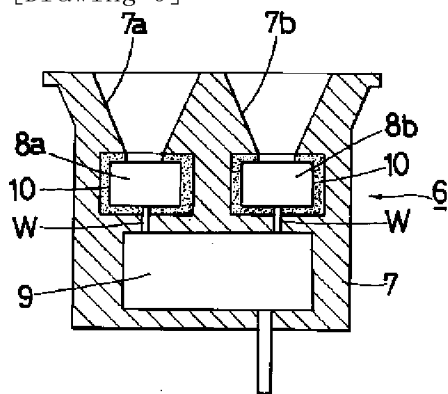
(a)



(b)



[Drawing 9]



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WRITTEN AMENDMENT

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----- [a procedure  
revision]

[Filing Date] April 1, Heisei 9

[Procedure amendment 1]

[Document to be Amended] Specification

[Item(s) to be Amended] 0010

[Method of Amendment] Modification

[Proposed Amendment]

[0010] However, if it is in the ultrasonic transducer 6 as shown in drawing 9 It compares with the ultrasonic transducer 1 using the ultrasonic vibrator 3 of a transmission-and-reception combination configuration as shown in drawing 6 . Since the effect by \*\*\*\* reverberation vibration ultrasonic vibrator 8a and whose ultrasonic vibrator 8b are another objects is mitigated, although short-distance ability to detect improves An ultrasonic vibrator, maintenance material, and every two horn sections needed to be prepared, respectively, and there was a trouble cost not only increases, but that a configuration will become large that it is hard to assemble.

[Procedure amendment 2]

[Document to be Amended] Specification

[Item(s) to be Amended] 0019

[Method of Amendment] Modification

[Proposed Amendment]

[0019] By the way, it is the next configuration that this ultrasonic vibrator 22 serves as the description. namely, diaphragm 22a1 for wave transmission from -- in order to transmit a supersonic wave, it is necessary to vibrate case section 22a for wave transmission by the supersonic wave of the frequency to be used, and to vibrate in 22d of piezoelectric devices for wave transmission near the resonance frequency of case section 22a for wave transmission Moreover, it is the diaphragm 22b1 for wave-receiving about the supersonic wave by which it reflects and comes on the contrary. If case section 22b for wave-receiving is not vibrated by the supersonic wave of the frequency to be used in order to receive waves and it is \*\*\*\*, there is nothing.

[Procedure amendment 3]

[Document to be Amended] Specification

[Item(s) to be Amended] 0021

[Method of Amendment] Modification

[Proposed Amendment]

[0021] Moreover, if it was in the conventional ultrasonic transducer which improved short-distance ability to detect, maintenance material holding an ultrasonic vibrator and an ultrasonic vibrator, such as silicone rubber, and every two horn sections prepared in housing needed to be prepared, respectively. If it is in this ultrasonic transducer 20 to it, since what is necessary is just to prepare every one horn section 21a prepared in the maintenance material 24 holding an ultrasonic vibrator 22 and an ultrasonic vibrator 22, such as silicone rubber, and housing 21 since it has connected with one through piece section of connection 22c, it can decrease, the cost can be cut down and, as for case section 22a for wave transmission, and case section 22b for wave-receiving, a configuration can also make small the number of components, and the number of assemblers.

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[Translation done.]



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特開平10-206529

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3 3 0 B

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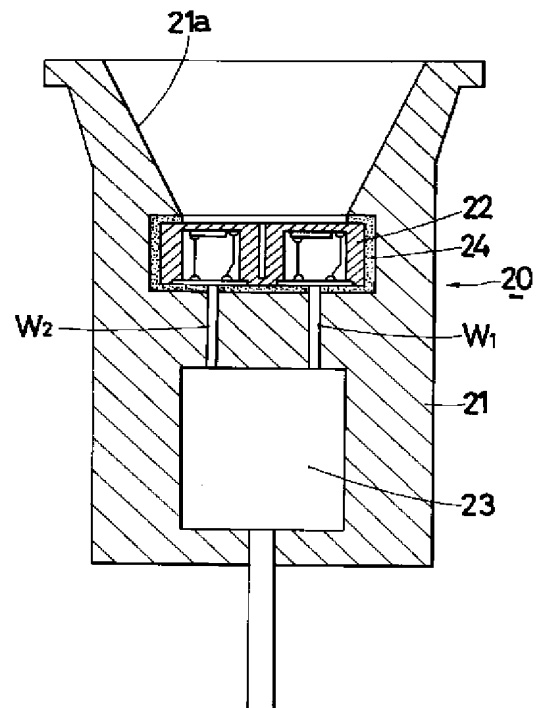
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(54)【発明の名称】 超音波送受波器

(57)【要約】

【課題】 小型化可能で且つ近距離検出能力の向上したものにする。

【解決手段】 送波用圧電素子を備え筒状体の一端を送波用振動板にて閉塞した送波用ケース部と、受波用圧電素子を備え筒状体の一端を受波用振動板にて閉塞した受波用ケース部と、送波用ケース部と受波用ケース部とを並列に連結する連結片部とを有する超音波振動子22を、ハウジング21内に収納した超音波送受波器20であって、連結片部により、送波用ケース部の開口部近傍と受波用ケース部の開口部近傍とでのみ、送波用ケース部と受波用ケース部とを連結するようにした。また、連結片部により連結した送波用ケース部と受波用ケース部との隙間に緩衝材を介在した。



**【特許請求の範囲】**

**【請求項1】** 送波用圧電素子を備え筒状体の一端を送波用振動板にて閉塞した送波用ケース部と、受波用圧電素子を備え筒状体の一端を受波用振動板にて閉塞した受波用ケース部と、送波用ケース部と受波用ケース部とを並列に連結する連結片部とを有する超音波振動子を、ハウジング内に収納した超音波送受波器であって、前記連結片部により、送波用ケース部の開口部近傍と受波用ケース部の開口部近傍とでのみ、送波用ケース部と受波用ケース部とを連結するようにしたことを特徴とする超音波送受波器。

**【請求項2】** 前記連結片部により連結した送波用ケース部と受波用ケース部との隙間に緩衝材を介在したことを特徴とする請求項1記載の超音波送受波器。

**【発明の詳細な説明】****【0001】**

**【発明の属する技術分野】**本発明は、超音波信号を送信するとともに障害物からの反射波を受信して障害物の存在を検出する超音波センサの、超音波送受波器に関する。

**【0002】**

**【従来の技術】**図5は超音波センサを示す原理説明図、図6は従来の超音波送受波器を示す断面図、図7は従来の超音波送受波器の超音波振動子を示す断面図である。図8は従来の超音波送受波器の送受波信号の説明図であり、図8(a)は送波信号の説明図、図8(b)は受波信号の説明図である。図9は従来の他の超音波送受波器を示す断面図である。

**【0003】**図5に示すように、超音波センサの原理は、前方に障害物Aが存在する場合、超音波送受波器1から前方空間に送波した超音波信号Bが障害物Aにて反射し、再び戻ってくるまでの所要時間に基づいて障害物Aまでの距離Lを検出するようにされている。

**【0004】**ところで、従来の超音波センサにあっては、図6に示すような超音波送受波器1が用いられている。すなわち、超音波送受波器1は、樹脂製の成形品で作られたハウジング2と、ハウジング2内に収納する超音波振動子3と回路ブロック4とを備える。ハウジング2は、前方へ効率よくビーム状に超音波を送波するためのホーン部2aを備える。超音波振動子3は、電気信号を機械的振動に変換して空気を直接振動したり、空気の振動を機械的振動に変換したうえで電気信号にしたりする部分であり、超音波の入出力する部分が開口するシリコンゴムなどの保持材5を介在してハウジング2内に収納する。回路ブロック4は、シールド線Wを介して電気信号を超音波振動子3へ供給したり、超音波振動子3から入力される電気信号を増幅したりする。

**【0005】**超音波振動子3は、詳しくは図7に示すように、筒状体の一端を薄板部3a<sub>1</sub>にて閉塞したアルミニウム製のケース3aと、ケース3aの薄板部3a<sub>1</sub>の

内面に貼着する小さな板状の圧電素子3bと、ケース3aの開口側を施蓋する回路基板3cとから構成される。回路基板3cにはシールド線Wが接続され、回路基板3cからは活線側のリード線3d<sub>1</sub>とアース側のリード線3d<sub>2</sub>とが引き出され、リード線3d<sub>1</sub>は圧電素子3bに接続し、リード線3d<sub>2</sub>は圧電素子3bの近傍の薄板部3a<sub>1</sub>に接続する。

**【0006】**上述のように構成される従来の超音波送受波器1は、図8に示すような超音波信号の送受波特性を備える。すなわち、図8(a)に示すような駆動信号を圧電素子3bに印加して薄板部3a<sub>1</sub>を振動させて超音波を送波すると、図8(b)に示すように残響振動による残響信号が駆動信号の後にあらわれ、圧電素子3bの駆動開始から $T=2L/V$ 秒後に障害物Aからの反射波が返ってくる。但し、Vは音速である。

**【0007】**

**【発明が解決しようとする課題】**従って、図5の超音波送受波器1と障害物Aとの距離が短くなればなるほど、図8(b)の障害物Aからの反射波は益々残響信号に近づき、反射波はついにはその残響信号の中に隠れてしまう。そのために、図6に示すような構成の従来の超音波送受波器1を備える超音波センサにあっては、障害物Aと超音波送受波器1との距離があまり接近すると障害物Aを検出できないことになる。

**【0008】**そこで、超音波振動子3の残響振動による近距離検出能力の低下を防止するために、残響振動の生じない送受別体型の超音波振動子を用いる超音波送受波器が考案されており、その超音波送受波器の構造を図9に示す。図9に示す超音波送受波器6は、樹脂製の成形品で作られたハウジング7と、ハウジング7内に収納する送波用の超音波振動子8aと受波用の超音波振動子8bと回路ブロック9とを備える。

**【0009】**ハウジング7は、前方へ効率よくビーム状に超音波を送波するためのホーン部7aと、前方から効率よく超音波を受波するためのホーン部7bとを備える。超音波振動子8aは電気信号を機械的振動に変換して空気を直接振動するものであり、超音波振動子8bは空気の振動を機械的振動に変換したうえで電気信号にするものである。超音波振動子8a、8bのそれぞれは、図7に示した超音波振動子と同様に構成されおり、超音波の入出力する部分が開口するシリコンゴムなどの保持材10を介在してハウジング7内に収納する。回路ブロック9は、シールド線Wを介して電気信号を超音波振動子8aへ供給したり、超音波振動子8bから入力される電気信号を増幅したりする。

**【0010】**しかしながら、図9に示すような超音波送受波器6にあっては、図6に示すような送受兼用構成の超音波振動子3を用いた超音波送受波器1と比較して、超音波振動子8aと超音波振動子8bとが別体であるぶん残響振動による影響が軽減されるため近距離検出能力

は向上するものの、超音波振動子、保持材およびホーン部をそれぞれ2つつ設ける必要があり、組み立て難くコストが嵩むだけでなく形状も大きくなってしまいう問題点があった。

【0011】本発明は上記の問題点を解決するために成されたもので、その目的とするところは、小型化可能で且つ廉価にして近距離検出能力の向上した、優れる超音波送受波器を提供することにある。

【0012】

【課題を解決するための手段】本発明は上記の問題点を解決するため、請求項1記載の発明にあっては、送波用圧電素子を備え筒状体の一端を送波用振動板にて閉塞した送波用ケース部と、受波用圧電素子を備え筒状体の一端を受波用振動板にて閉塞した受波用ケース部と、送波用ケース部と受波用ケース部とを並列に連結する連結片部とを有する超音波振動子を、ハウジング内に収納した超音波送受波器であって、前記連結片部により、送波用ケース部の開口部近傍と受波用ケース部の開口部近傍とでのみ、送波用ケース部と受波用ケース部とを連結するようにしたことを特徴とする。

【0013】また、請求項2記載の発明にあっては、前記連結片部により連結した送波用ケース部と受波用ケース部との隙間に緩衝材を介在したことを特徴とする。

【0014】

【発明の実施の形態】以下、本発明に係る超音波送受波器の一実施の形態を図1～図3に基づいて、他の実施の形態を図4に基づいて、それぞれ詳細に説明する。

【0015】図1は超音波送受波器を示す断面図である。図2は超音波振動子を示す図であり、図2(a)は平面図、図2(b)は断面図である。図3は振動モードを説明する側面図である。図4は他の実施の形態の超音波送受波器の超音波振動子を示す図であり、図4(a)は平面図、図4(b)は断面図である。

【0016】超音波送受波器20は、樹脂製の成形品で作られたハウジング21と、ハウジング21内に収納する超音波振動子22と回路ブロック23とを備える。ハウジング21は、前方へ効率よくビーム状に超音波を送波するためのホーン部21aを備える。超音波振動子22は、電気信号を機械的振動に変換して空気を直接振動したり、空気の振動を機械的振動に変換したうえで電気信号に変換したりする部分であり、超音波の入出力する部分が開口するシリコンゴムなどの保持材24を介在してハウジング21内に収納する。回路ブロック23は、シールド線W<sub>1</sub>を介して電気信号を超音波振動子22へ供給したり、シールド線W<sub>2</sub>を介して超音波振動子22から入力される電気信号を増幅したりする。

【0017】超音波振動子22は、詳しくは図2に示すように、筒状体の一端を送波用振動板22a<sub>1</sub>にて閉塞したアルミニウム製の送波用ケース部22aと、筒状体の一端を受波用振動板22b<sub>1</sub>にて閉塞したアルミニウ

ム製の受波用ケース部22bと、送波用ケース部22aと受波用ケース部22bとを連結する連結片部22cと、送波用ケース部22aの送波用振動板22a<sub>1</sub>の内面に貼着する小さな板状の送波用圧電素子22dと、受波用ケース部22bの受波用振動板22b<sub>1</sub>の内面に貼着する小さな板状の受波用圧電素子22eと、送波用ケース部22aの開口部を施蓋する回路基板22fと、受波用ケース部22bの開口部を施蓋する回路基板22gとから構成される。

【0018】回路基板22fにはシールド線W<sub>1</sub>が接続され、回路基板22gにはシールド線W<sub>2</sub>が接続される。回路基板22fからは活線側のリード線22h<sub>1</sub>とアース側のリード線22h<sub>2</sub>とが引き出され、リード線22h<sub>1</sub>は送波用圧電素子22dに接続し、リード線22h<sub>2</sub>は送波用圧電素子22dの近傍の送波用振動板22a<sub>1</sub>に接続する。また、回路基板22gからは活線側のリード線22i<sub>1</sub>とアース側のリード線22i<sub>2</sub>とが引き出され、リード線22i<sub>1</sub>は受波用圧電素子22eに接続し、リード線22i<sub>2</sub>は受波用圧電素子22eの近傍の受波用振動板22b<sub>1</sub>に接続する。

【0019】ところで、この超音波振動子22が特徴となるのは次の構成である。すなわち、送波用振動板22a<sub>1</sub>から超音波を送波するには、使用する周波数の超音波で送波用ケース部22aを振動させなければならず、送波用ケース部22aの共振周波数近傍で送波用圧電素子22dを振動する必要がある。また、反射して返ってくる超音波を受波用振動板22b<sub>1</sub>にて受波するには、使用する周波数の超音波で受波用ケース部22bを振動させなければならぬ。

【0020】そこで、使用する超音波の周波数に基づいて送波用ケース部22aと受波用ケース部22bとを設計することになるが、送波用ケース部22aと受波用ケース部22bとのそれぞれは、使用する周波数の超音波で、図3に示すように、開口部がちょうど節（振幅が最小）になるモードで共振する。従って、連結片部22cを以て、送波用ケース部22aの開口部近傍と受波用ケース部22bの開口部近傍とを連結すると、使用する周波数の超音波で共振するときに節（振幅が最小）になる部分で連結することになり、送波用振動板22a<sub>1</sub>から超音波を送波するときの送波用ケース部22aの振動は連結片部22cを介して受波用ケース部22bに伝わらず、残響振動による影響を軽減することができ、近距離検出能力の向上したものにできる。

【0021】また、近距離検出能力を向上した従来の超音波送受波器にあっては、超音波振動子、超音波振動子を保持するシリコンゴムなどの保持材、および、ハウジングに設けるホーン部は、それぞれ2つつ設ける必要があった。それに対し、この超音波送受波器20にあっては、送波用ケース部22aと受波用ケース部22bとは連結片部22cを介して一体に連結しているので、超

音波振動子22、超音波振動子22を保持するシリコンゴムなどの保持材24、および、ハウジング21に設けるホーン部21aは1つつ設けるだけで良いので部品数および組み立て工数を減少することができ、コストダウンが可能で形状も小型にできる。

【0022】また、図4に示すように、超音波や振動を吸収遮断するスポンジゴムのような緩衝材25を、送波用ケース部22aと受波用ケース部22bとの隙間に介在すると、更に送波用ケース部22aの振動を受波用ケース部22bに伝わり難くすることができ、小型化可能で且つ廉価にして更に近距離検出能力の向上した優れた超音波送受波器を提供できる。

#### 【0023】

【発明の効果】請求項1記載の発明によれば、連結片部を介して送波用ケース部と受波用ケース部とを連結するので、部品数および組み立て工数を減少することができ、コストダウンが可能で形状も小型にでき、しかも、使用する周波数の超音波による送波用ケース部の振動モードの節の部分で、連結片部を介して、送波用ケース部と受波用ケース部とを連結することになるので、送波用ケース部の送波時の振動が受波用ケース部に伝わり難く、小型化可能で且つ廉価にして近距離検出能力の向上した、優れた超音波送受波器を提供できるという効果を奏する。

【0024】請求項2記載の発明によれば、送波用ケース部と受波用ケース部との隙間に緩衝材を介在するので、請求項1記載の発明の効果に加えて、更に送波用ケース部の振動を受波用ケース部に伝わり難くすることができ、更に近距離検出能力を向上した、優れた超音波送

受波器を提供できるという効果を奏する。

#### 【図面の簡単な説明】

【図1】本発明に係る一実施の形態の超音波送受波器を示す断面図である。

【図2】上記超音波送受波器の超音波振動子を示す図である。

【図3】上記超音波送受波器の超音波振動子の振動モードを説明する側面図である。

【図4】本発明に係る他の実施の形態の超音波送受波器の超音波振動子を示す断面図である。

【図5】超音波センサを示す原理説明図である。

【図6】従来の超音波送受波器を示す断面図である。

【図7】従来の超音波送受波器の超音波振動子を示す断面図である。

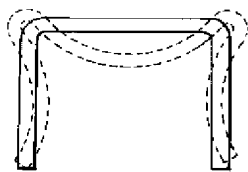
【図8】従来の超音波送受波器の送受波信号の説明図である。

【図9】従来の他の超音波送受波器を示す断面図である。

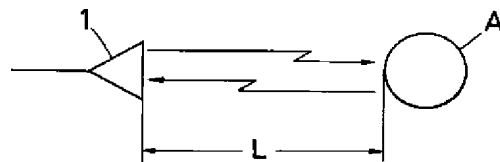
#### 【符号の説明】

- 20 超音波送受波器
- 21 ハウジング
- 22a 送波用ケース部
- 22a<sub>1</sub> 送波用振動板
- 22b 受波用ケース部
- 22b<sub>1</sub> 受波用振動板
- 22d 送波用圧電素子
- 22e 受波用圧電素子
- 22c 連結片部
- 25 緩衝材

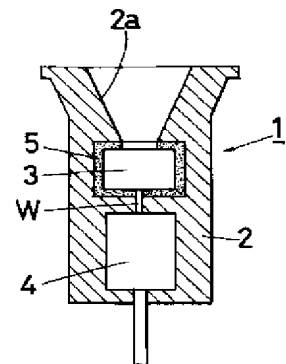
【図3】



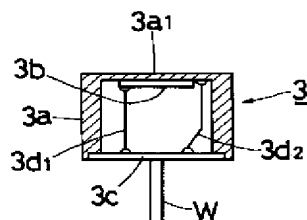
【図5】



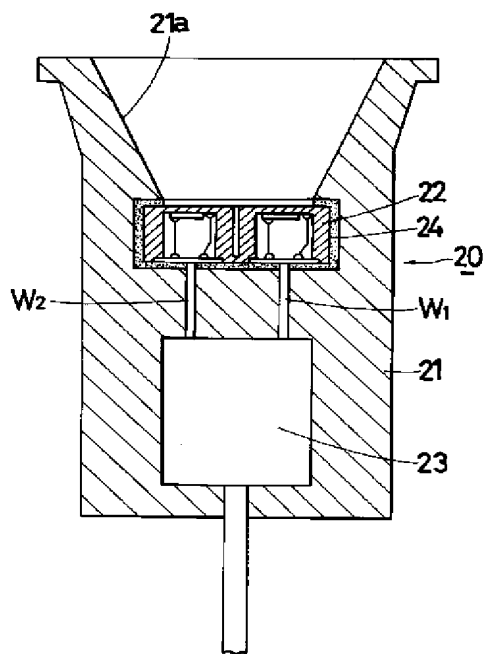
【図6】



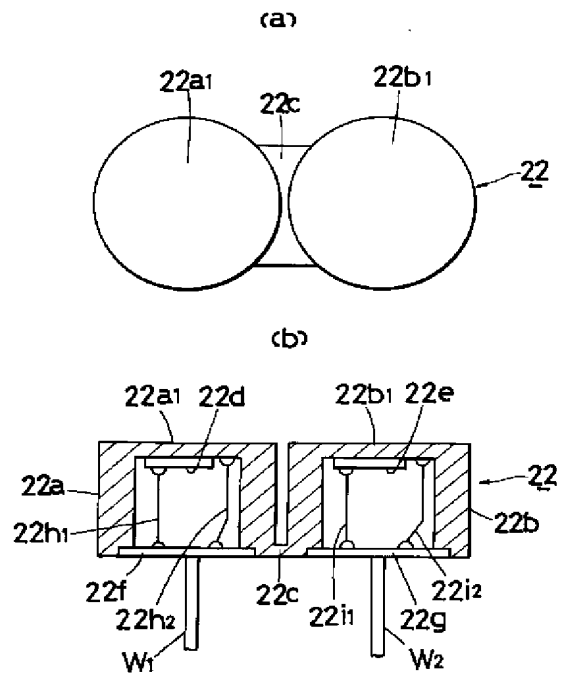
【図7】



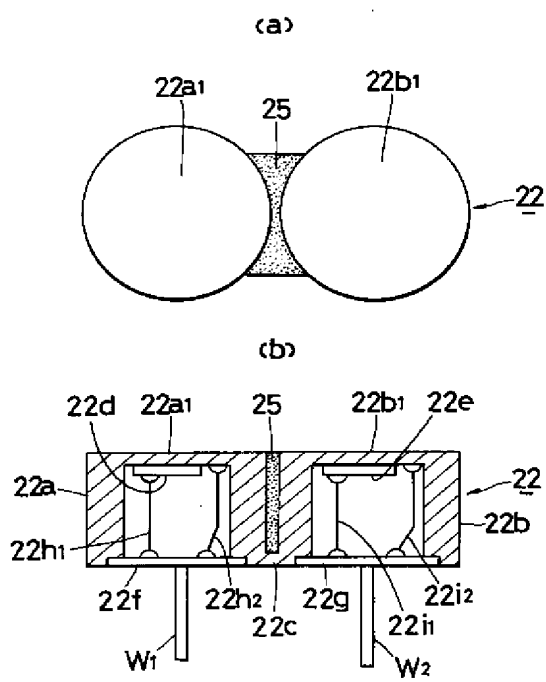
【図1】



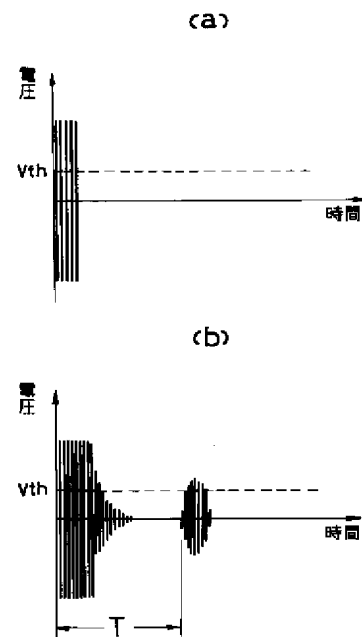
【図2】



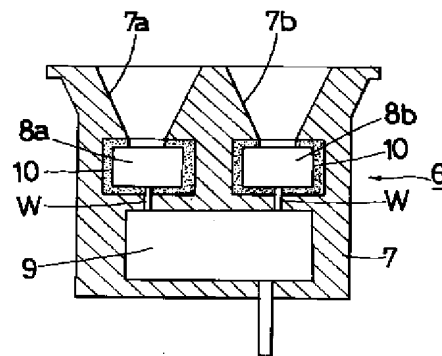
【図4】



【図8】



【図9】



## 【手続補正書】

【提出日】平成9年4月1日

## 【手続補正1】

【補正対象書類名】明細書

【補正対象項目名】0010

【補正方法】変更

【補正内容】

【0010】しかしながら、図9に示すような超音波送受波器6にあっては、図6に示すような送受兼用構成の超音波振動子3を用いた超音波送受波器1と比較して、超音波振動子8aと超音波振動子8bとが別体であるぶん残響振動による影響が軽減されるため近距離検出能力は向上するものの、超音波振動子、保持材およびホーン部をそれぞれ2つずつ設ける必要があり、組み立て難くコストが嵩むだけでなく形状も大きくなってしまいう問題点があった。

## 【手続補正2】

【補正対象書類名】明細書

【補正対象項目名】0019

【補正方法】変更

【補正内容】

【0019】ところで、この超音波振動子22が特徴となるのは次の構成である。すなわち、送波用振動板22a<sub>1</sub>から超音波を送波するには、使用する周波数の超音

波で送波用ケース部22aを振動させなければならず、送波用ケース部22aの共振周波数近傍で送波用圧電素子22dを振動する必要がある。また、反射して返ってくる超音波を受波用振動板22b<sub>1</sub>にて受波するには、使用する周波数の超音波で受波用ケース部22bを振動させなければならない。

## 【手続補正3】

【補正対象書類名】明細書

【補正対象項目名】0021

【補正方法】変更

【補正内容】

【0021】また、近距離検出能力を向上した従来の超音波送受波器にあっては、超音波振動子、超音波振動子を保持するシリコンゴムなどの保持材、および、ハウジングに設けるホーン部は、それぞれ2つずつ設ける必要があった。それに対し、この超音波送受波器20にあっては、送波用ケース部22aと受波用ケース部22bとは連結片部22cを介して一体に連結しているので、超音波振動子22、超音波振動子22を保持するシリコンゴムなどの保持材24、および、ハウジング21に設けるホーン部21aは1つずつ設けるだけで良いので部品数および組み立て工数を減少することができ、コストダウンが可能で形状も小型にできる。